

**APPLICATION FOR UNITED STATES PATENT**

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**INVENTION:** Method and Apparatus for Welding with Start  
Control

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**SPECIFICATION**

## **Method and Apparatus for Welding with Start Control**

### **FIELD OF THE INVENTION**

The present invention relates generally to the art of providing welding power. More specifically, it relates to providing welding power with a controlled start.

### **BACKGROUND OF THE INVENTION**

Electric arc welding is well known, and is performed with a variety of processes using a variety of types of equipment. One electric arc welding process is a pulse spray process, which is typically performed using a wire feeder and a power supply. An example of a prior art power supply used in pulse spray welding is a Miller S64M™ wire feeder. The Miller S64M™ wire feeder may be used with a Miller XMT304™ power supply.

Typically, a pulse spray welding power supply includes a wire feeder, a power source, and a controller, which may be disposed in the same or separate housings. Power is provided from the power source to the wire feeder, and the wire feeder provides the wire and power to the arc. The wire feeder typically includes a controller, which may be part of or separate from the wire feeder, and which controls the wire feed speed based on at least one user-selected input. Additionally, the controller provides a command signal to the power supply which causes the power supply to output a current and voltage at a desired magnitude. The command is produced in response to a user-selected wire feed speed. The power supply provides a specified current by adjusting the output voltage until the desired current is

obtained. The current amplitude is often controlled as a function of time, switching between a background current and a peak current, thus creating a pulsed output.

Many prior art systems start a welding process by providing a run-in time, during which wire is fed to the arc at a run-in speed. This allows the wire to move to the work piece. Then, after the run-in ends, the wire is fed at the user selected rate. The run-in may be terminated when the wire reaches the workpiece, or when the arc starts. However, at times the user touches the wire to the workpiece before starting the welding process (by pulling the trigger on the torch). This can cause difficult starts.

Accordingly, it is desirable that a welding power supply and wire feeder include a controller that helps start the weld properly, particularly when the wire is touching the workpiece.

#### SUMMARY OF THE PRESENT INVENTION

According to a first aspect of the invention a welding power supply having a start control includes, a source of welding power, a wire feeder and a controller. The source of welding power has at least one power control input, and provides welding power to an arc. The wire feeder has a feeder control input, and provides wire to the arc. The controller has a wire feed control output connected to the feeder control input, and a power source control output connected to the power control input. The controller also has a wire feed delay module, having as an input a user trigger signal, and having as an output the wire feed control output and the source of power control output.

The welding wire feed delay module provides a wire feed delay of 20 milliseconds, or in response to output feedback.

The welding power is provided to the arc through the wire feeder in another alternative.

The controller includes one or more of a pulse module, a CC module, a CV module, and a run-in module in various alternatives. They may operate sequentially, after the delay, in the order above, or in another order.

Other principal features and advantages of the invention will become apparent to those skilled in the art upon review of the following drawings, the detailed description and the appended claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is block diagram of a welding system in accordance with the preferred embodiment of the present invention.

Before explaining at least one embodiment of the invention in detail it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting. Like reference numerals are used to indicate like components.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the present invention will be illustrated with reference to a particular system and method, it should be understood at the outset that the invention may be implemented with other systems and methods.

Generally, the invention provides for starting the welding process in such a way as to avoid difficult starts, particularly when the wire is touching the workpiece when the user pulls the trigger. More specifically, the invention provides for sensing the pulling of the trigger, and in response thereto providing welding power, while delaying the start of wire feeding. The delay is approximately 20 milliseconds in the preferred embodiment, although other delays are used in other embodiments. The welding power is provided at the user set power in one embodiment, although other power levels, such as maximum power, a variable power, or a predetermined power, are provided in various alternatives.

If the wire is touching the workpiece, because the user positioned it incorrectly, or for some other reason, a short circuit will exist, and the output power will cause the tip of the wire to melt, creating an arc. If the wire is not touching the workpiece, there will be an open circuit, and current will not flow until the wire touches the workpiece, or an arc is formed. Thus, the art should start properly even when the wire is touching the workpiece.

The preferred embodiment uses a wire feeder design similar to the Miller S64M™ and a power supply design similar to the Miller XMT304™ power supply, but packaged in a single housing, or a MM251®, or such as that described in

US Patent 6,107,602. The preferred wire feeder includes a digital controller, which includes a microprocessor and an EPROM memory. The controller, as described above, sets welding parameters according to factory set, or user-set, programs.

Alternative embodiments provide that the controller is part of the power supply, or in a separate housing.

After the delay has ended, the controller causes wire to be fed at the user set rate. Other embodiments provide for wire to be fed at a run-in rate after the delay has ended.

The invention contemplates that, during (or after) the delay, either the user set power or power determined by another starting routine will be provided. In the preferred embodiment a starting routine such as that available on the Miller Axcess® power supply is provided. Generally, that routine provides for starting the pulse welding process by providing a constant current (CC) type power output to initiate the arc, followed by a constant voltage (CV) type power to maintain the arc, and then transitioning to a pulse type power to perform the pulse process.

The welding output is commanded to a CC output one millisecond after the start of the delay in the preferred embodiment. Preferably, the commanded level is high, such as about 600 amps. Then, after a millisecond of CC output, the output is commanded to a CV output for a time dependent on the welding program selected. Other parameters may be used to terminate the CV phase. Following the CV phase the output is changed to the user selected power, such as pulse, or MIG.

Another alternative provides for different time periods, different outputs, and ending the delay period upon sensing an open circuit (such as by using output voltage, current, or functions thereof), or in response to another feedback parameter. Delay, as used herein, is not limited to a period ending after a determined time, but may be a length of time determined by other parameters.

Referring now to Figure 1, a welding system or power supply 100 in accordance with the preferred embodiment includes a controller 102, a wire feeder 103 and a power source 104, that cooperate to weld at an arc 106. Welding power supply, as used herein, includes any system capable of supplying welding power including resonant power supplies, quasi-resonant power supplies, etc., as well as control circuitry and other ancillary circuitry associated therewith. Controller, as used herein, includes digital and analog circuitry, discrete or integrated circuitry, DSPs, microprocessors, etc., and software, hardware and firmware, located on one or

more boards, used to control a device such as a power supply. Power source, or source of power, as used herein, includes the power circuitry such as rectifiers, switches, transformers, SCRs, etc. that process and provide the output power. Arc, as used herein refers to the tip of the wire, the electrode, and any gap therebetween, and includes shorts, and includes open circuits.

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Controller 102 includes a plurality of modules that perform various functions. The modules provide control signals, such as a wire feed control output 115 to a feeder control input and a power source control output 116 to a power source control input. Module, as used herein, includes software and/or hardware that cooperates to perform one or more tasks, and can include digital commands, control circuitry, power circuitry, networking hardware, etc.

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The preferred embodiment includes a wire feed delay module 110, that operates in response to sensing a user trigger on 117. After the delay, a CV control module 111 provides a CV control output (i.e., control signals used for CV welding). After the CV control ends a CC control module 112 provides a CC control output. After the CC control ends, a pulse module 112 provides a pulse control output. A run-in control module operates before the CV control module, but after the delay, in alternative embodiments.

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Numerous modifications may be made to the present invention which still fall within the intended scope hereof. Thus, it should be apparent that there has been provided in accordance with the present invention a method and apparatus for in welding power supply with a controlled start that fully satisfies the objectives and advantages set forth above. Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

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